Environmental Performance Surface for Support Underwater Laser Imaging Systems &Diver Operations

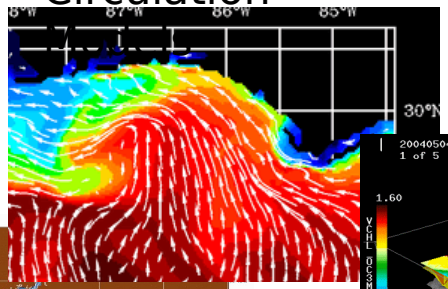
S. Ladner, R. Arnone, A. Weidemann
Stennis Space Center, MS

Proposed support to Vulcan Ex March 2011

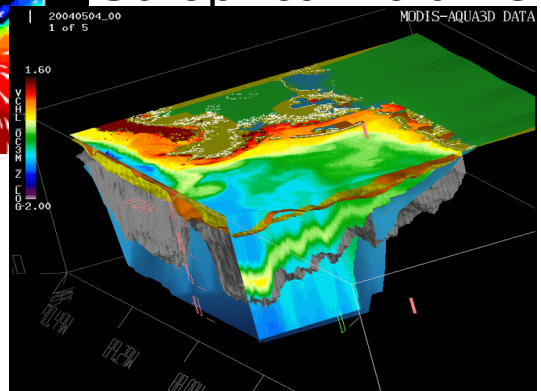
me Environmental characterization for the Northern Gulf of Mexi

a) Forecasting the Optical Environment ✉ Impact on systems (ASQ 24) and Diver visibility
b) Vertical optical layers
c) daily and 24 hour forecast of the EOIDS performance

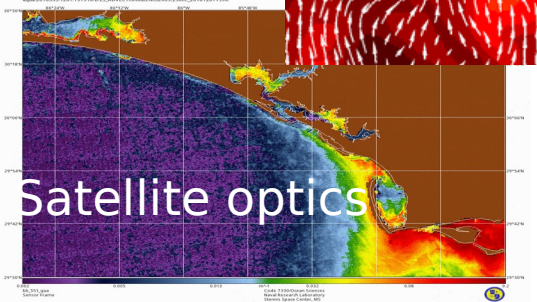
Circulation



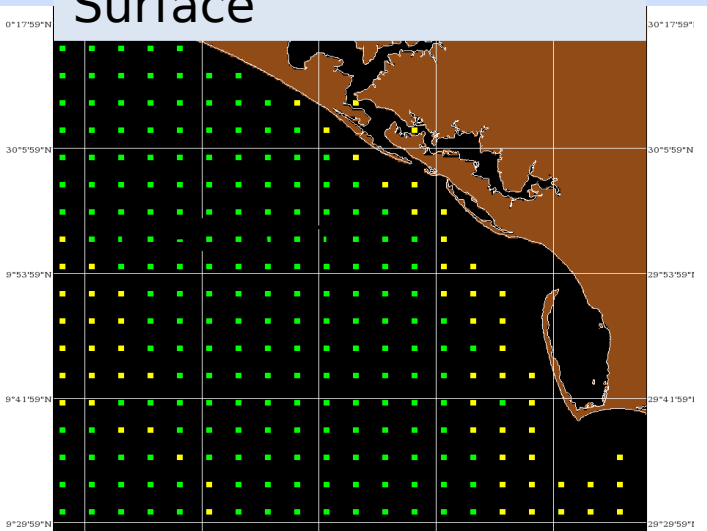
3d optical volume



Satellite optics

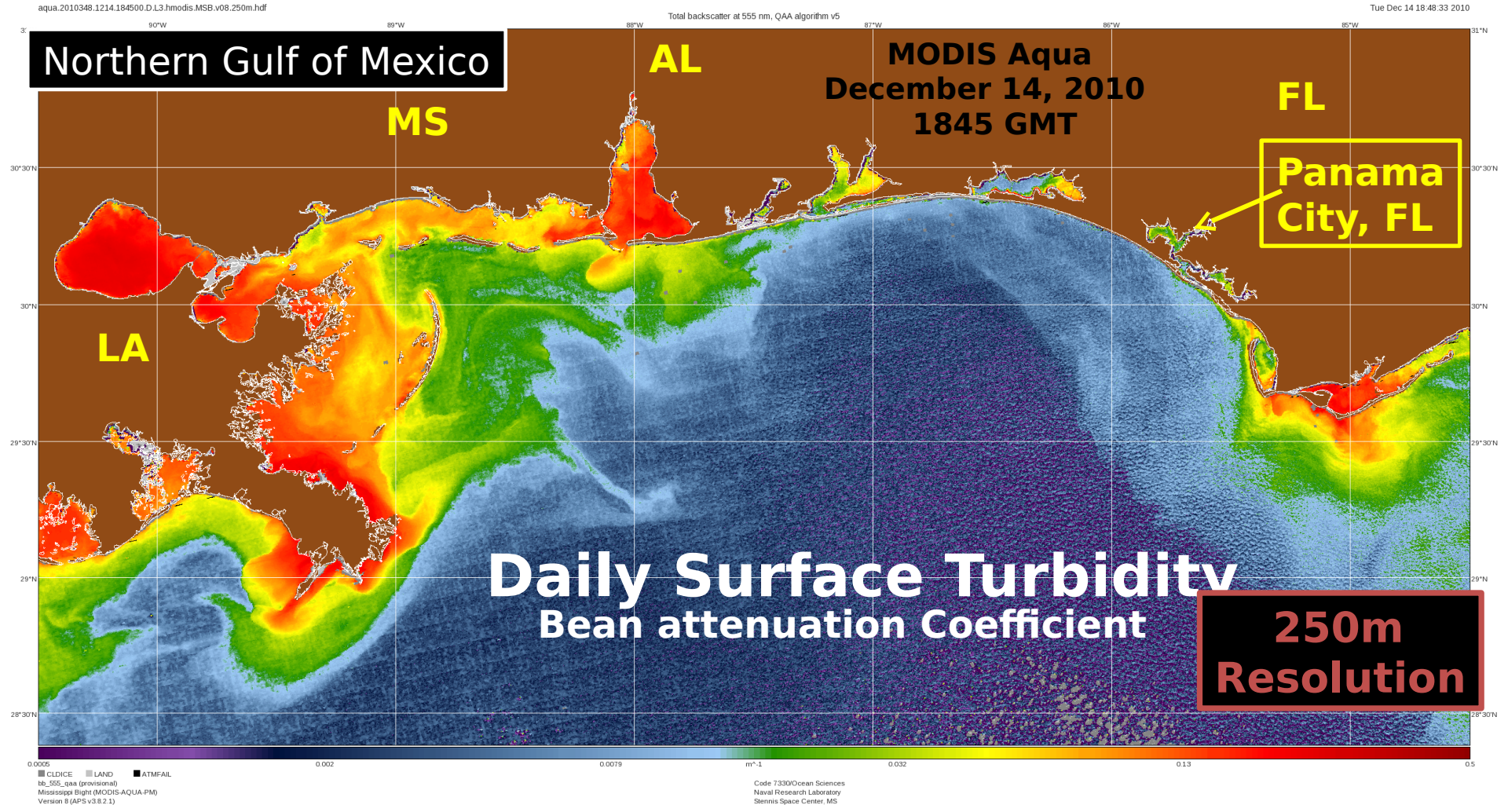


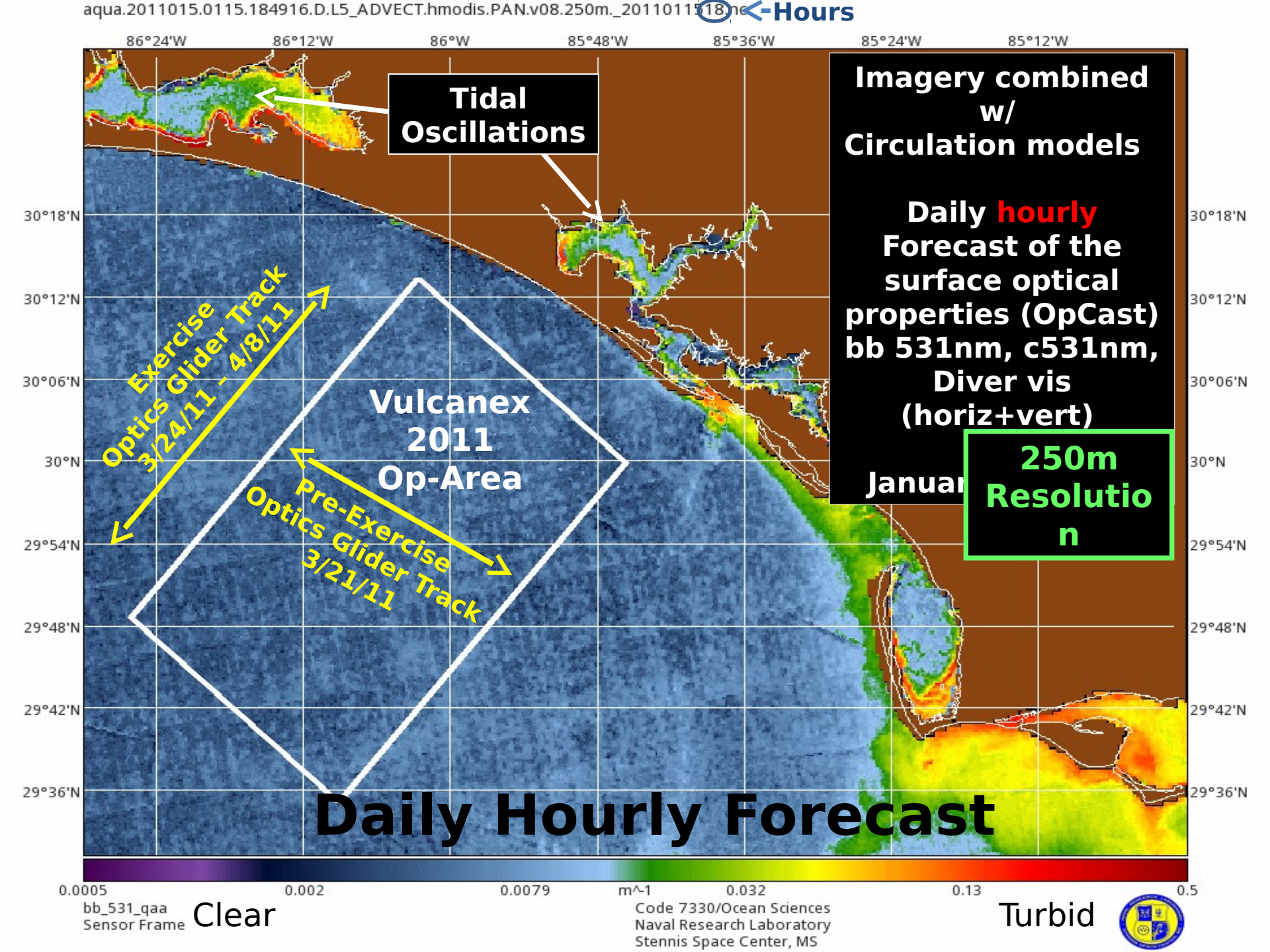
EOID performance Surface



Background:

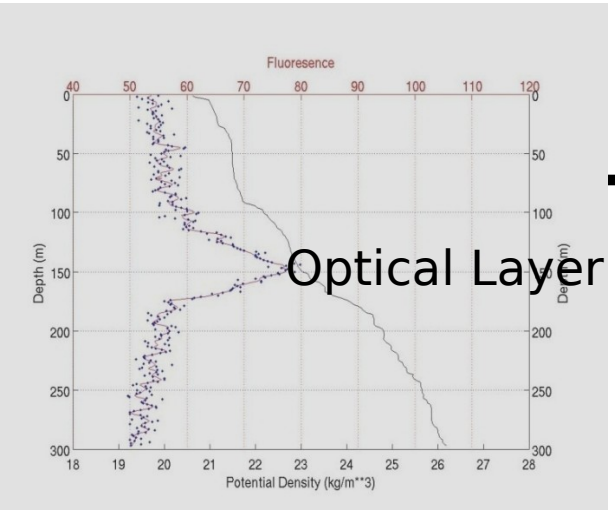
Satellite ocean color Imagery from provides real tim monitoring of the optical properties in the Gulf



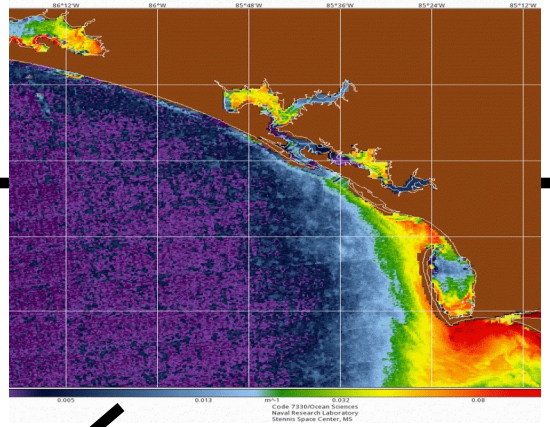

aqua.2011015.0115.184916.D.L5_ADVECT.hmodis.PAN.v08.250m._201101151816.nc
<-Hours
86°24'W
86°12'W
86°W
85°48'W
85°36'W
85°24'W
85°12'W
30°18'N
30°12'N
30°06'N
30°N
29°54'N
29°48'N
29°42'N
29°36'N
Tidal Oscillations
Imagery combined w/ Circulation models
Daily hourly Forecast of the surface optical properties (OpCast) bb 531nm, c531nm, Diver vis (horiz+vert)
Januar
250m Resolution
Exercise Optics Glider Track 3/24/11 - 4/8/11
Vulcanex 2011 Op-Area
Pre-Exercise Optics Glider Track 3/21/11
Daily Hourly Forecast
0.0005
0.002
0.0079
m^-1
0.032
0.13
0.5
bb_531_qaa
Sensor Frame
Clear
Code 7330/Ocean Sciences
Naval Research Laboratory
Stennis Space Center, MS
Turbid

Fusion of Glider Profiles, Satellite and Numerical Models to support AQS24 Operations

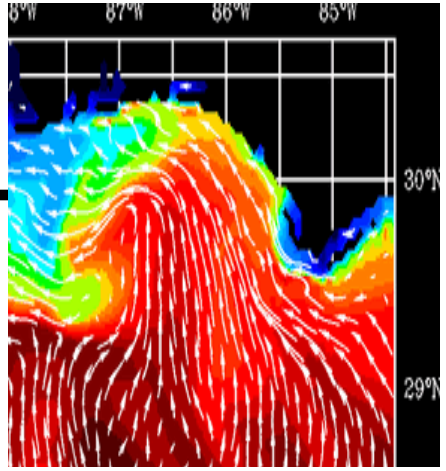
Vertical Optical Profiles
(Glider, BSP, etc.)



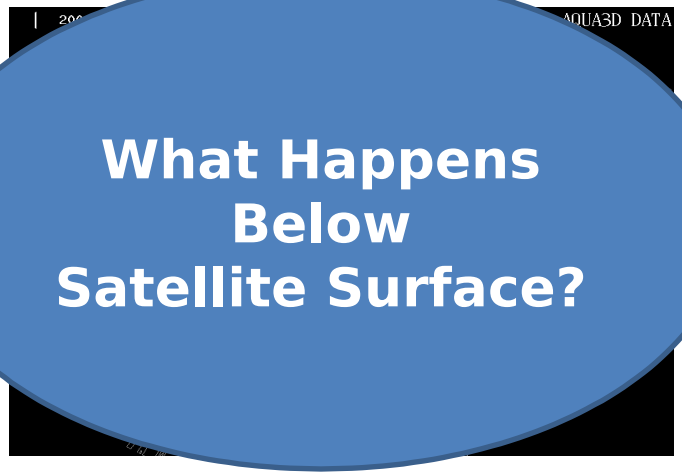
Real-Time Satellite Optics



Circulation Models



What Happens Below Satellite Surface?

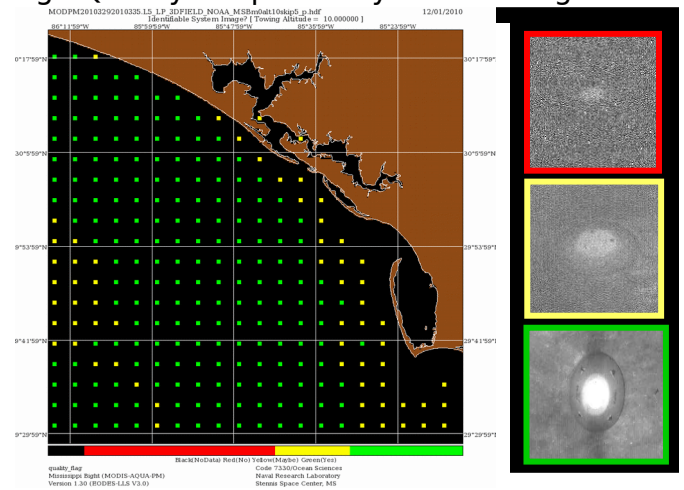


3D Optical Volume

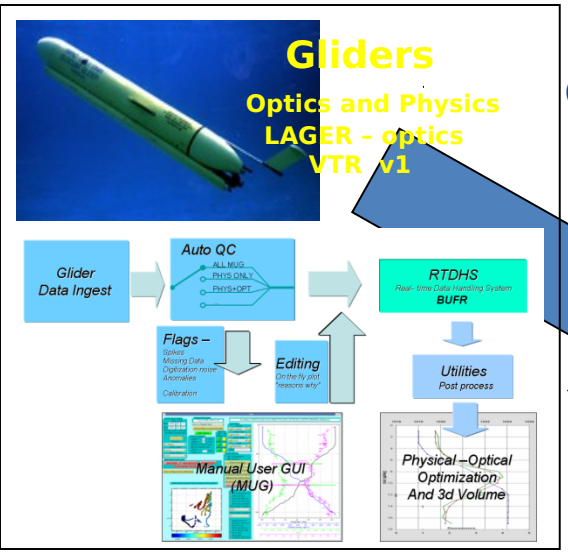
EODES

Laser System Performance Surface Ma

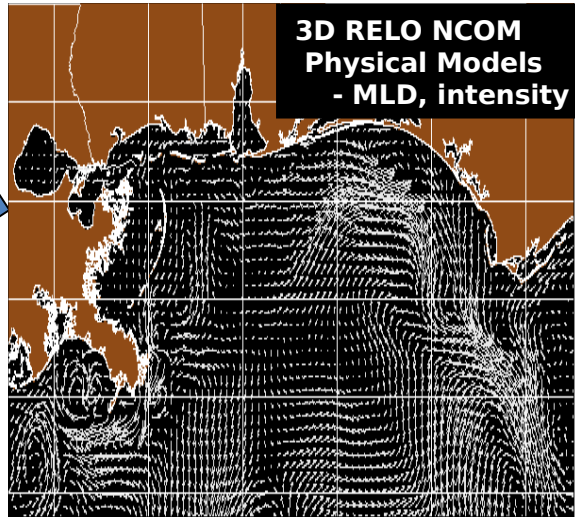
Image Quality & Optimal System Towing Altitude

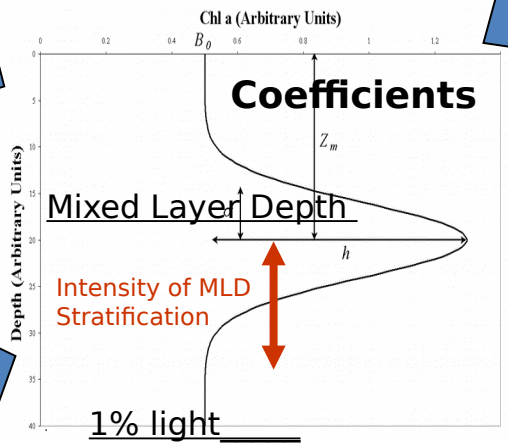


Generation of the 3D Optical Volume (3DOG)

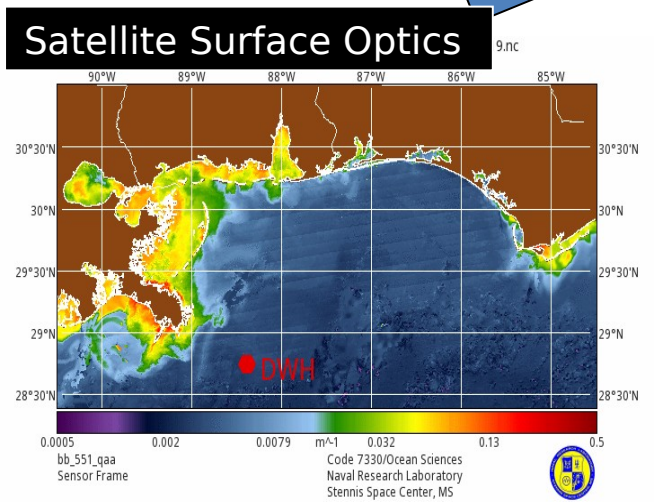


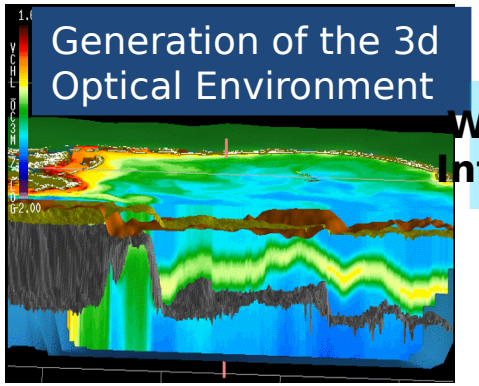
"Fusion of the data sources"
Optics (surface) to physics (subsurface)
Derived through optimization of a Gaussian Model



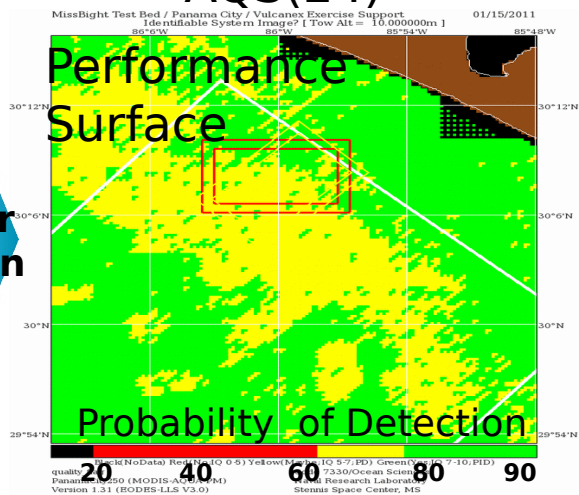


Environmental Decision Aides
For Operational Planning
EOIDS (EODES)
AQS(24)

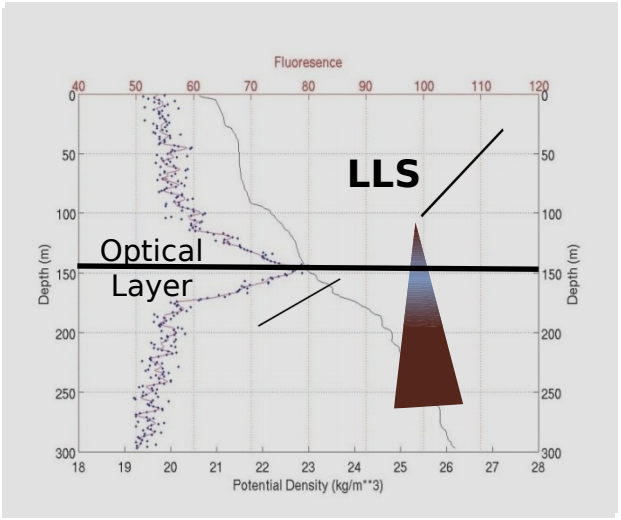




Warfighter Information



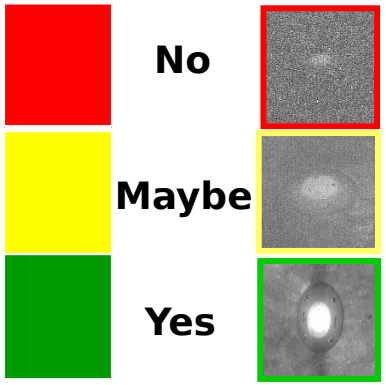
System Performance Surfaces (AQS-24)



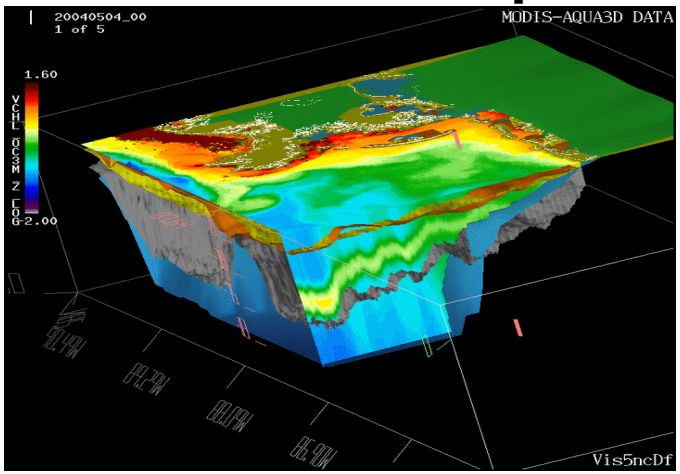
EODES Point Glider Performance

Tow Above/Below Optical Layer

Target ID?

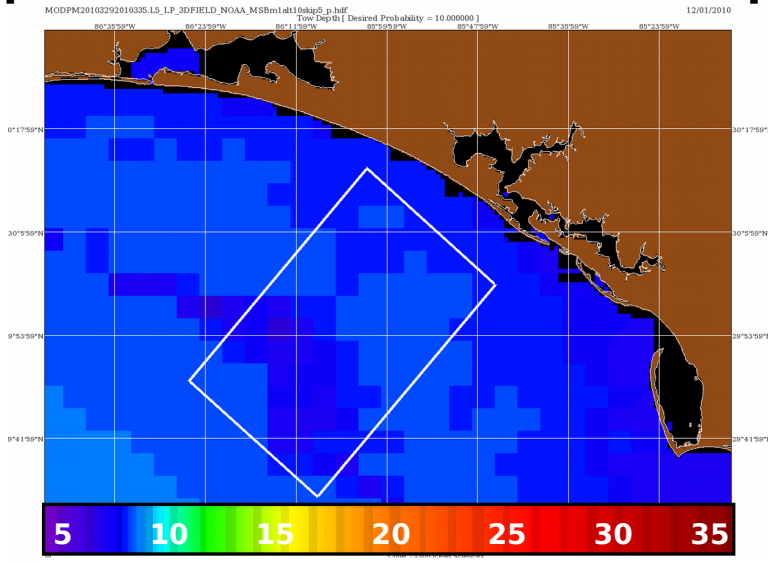


nd Vertical Glider Profiles Spatially
y EODES to the 3D Optical Volume



EODES Spatial Performance

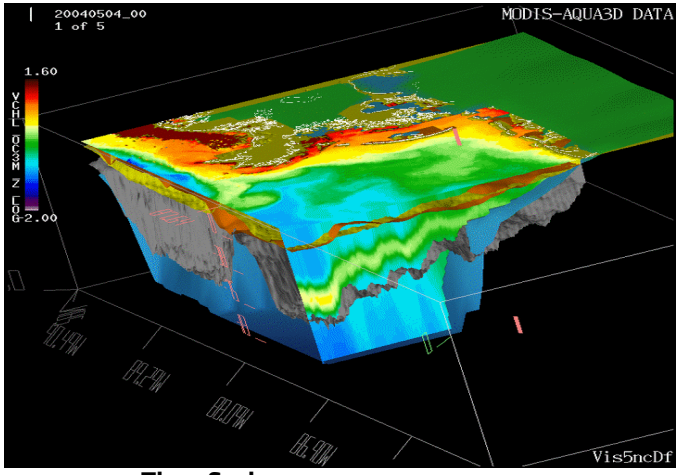
Spatial Performance Surface Map

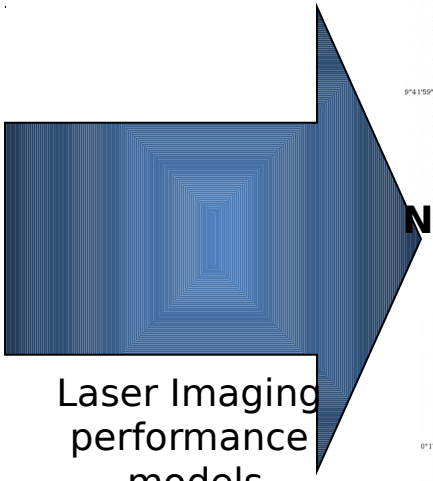


Sensor Optimal Tow Altitude

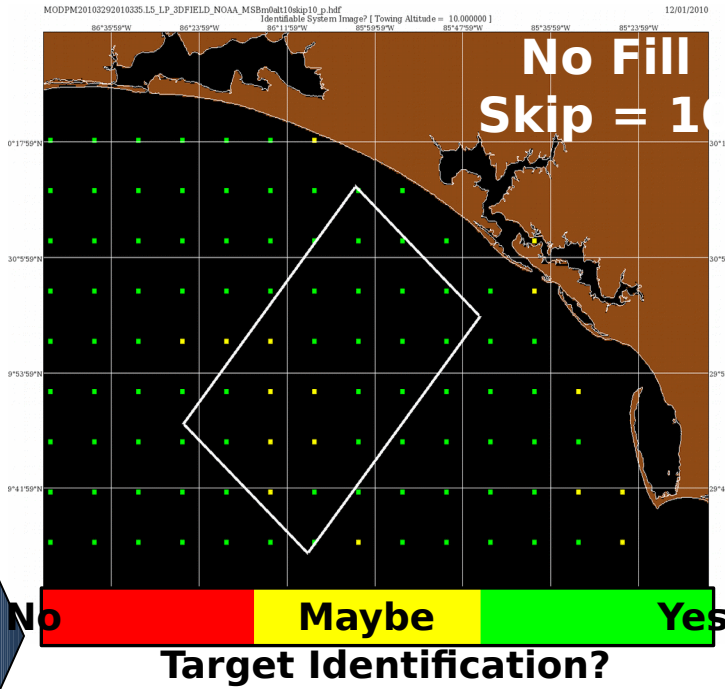
Performance Fields

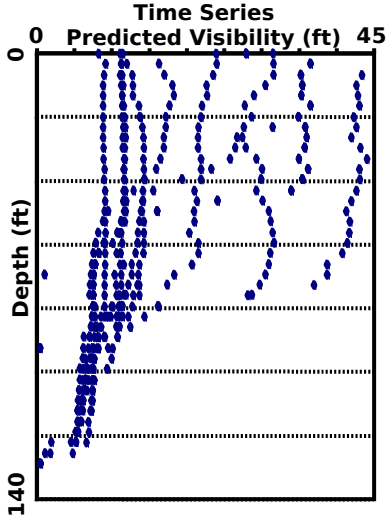
Battlespace Characterization
3d optical profiles





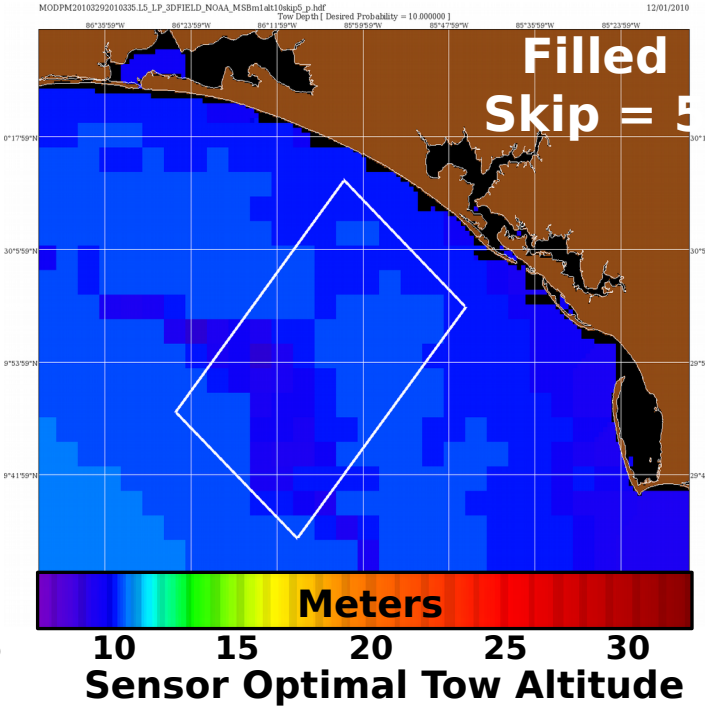
Laser Imaging performance models





Vertical Optical profile

Laser Line Scanner

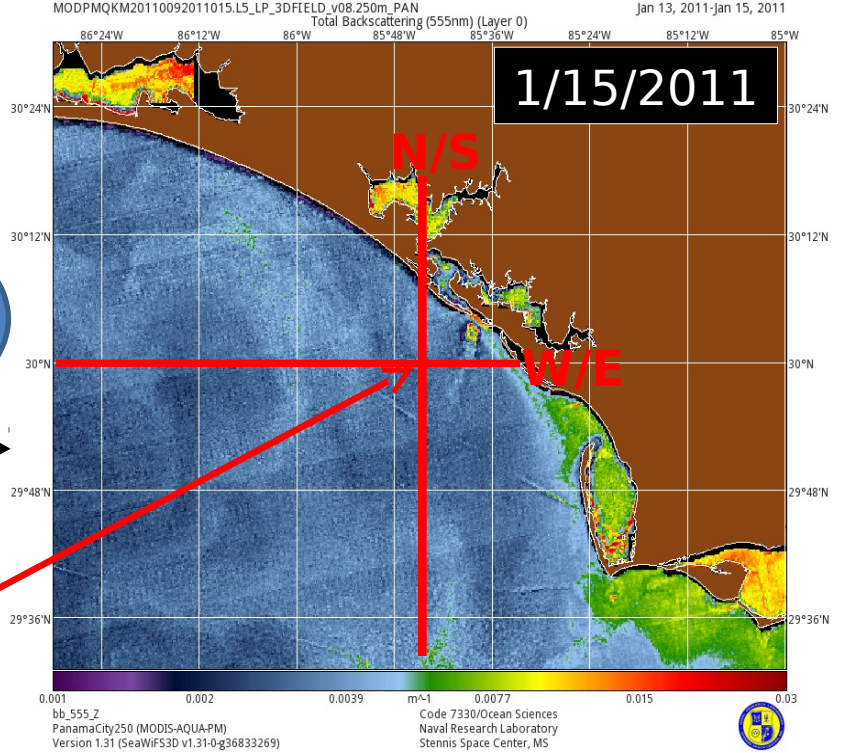


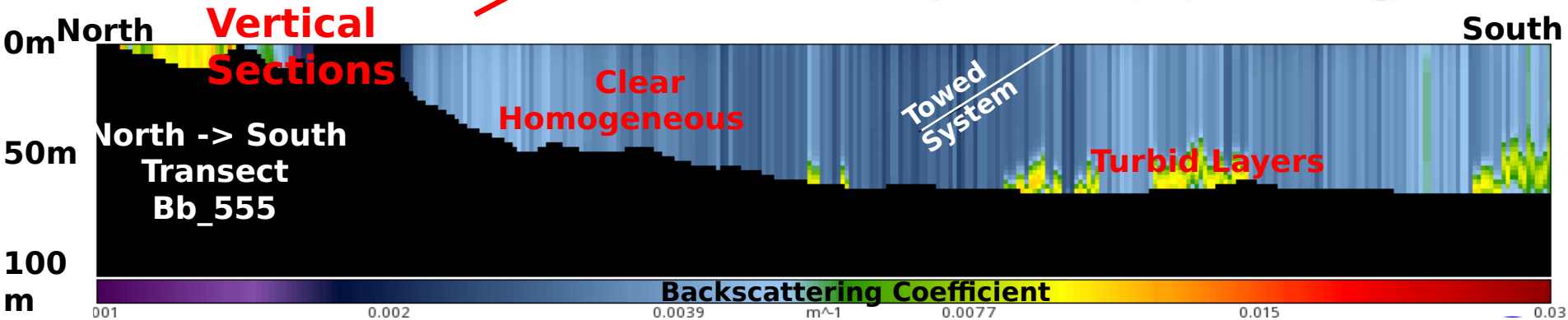
250m Resolution

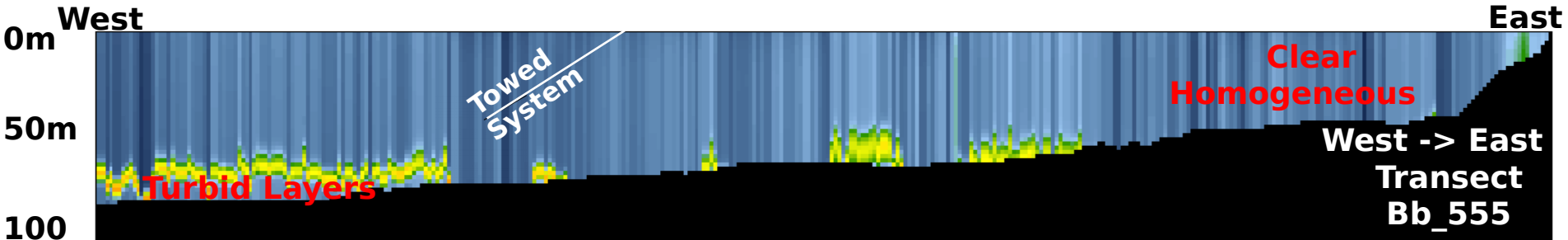
3D Optical Volume Created by Merging "Satellite, models and Insitu data "

Surface to Bottom Animation (Black Areas are Bottom)

ts Need Tuning Daily Using Glider







Data Requested for NRL participation

- **Satellite data**
- **Ocean Models**
- **Vertical Optical Profiles**
 - **BSP (transmissometer)**
 - **Slocum Gliders (attenuation meter)**
- **Laser Line scan Image Snipits**
- **Feedback From Diver Ops (If Available)**

Required	Requested 1	Requested 2	
a			Satellite data stream in place
a			Data stream in place
			Profiles use for: tuning optical Volume & validation
	a		
		a	
		a	Images used for validation
		a	Visibility Reports

Daily Exercise Support Products

VULCANEX (3/21/11 – 4/11/11?)

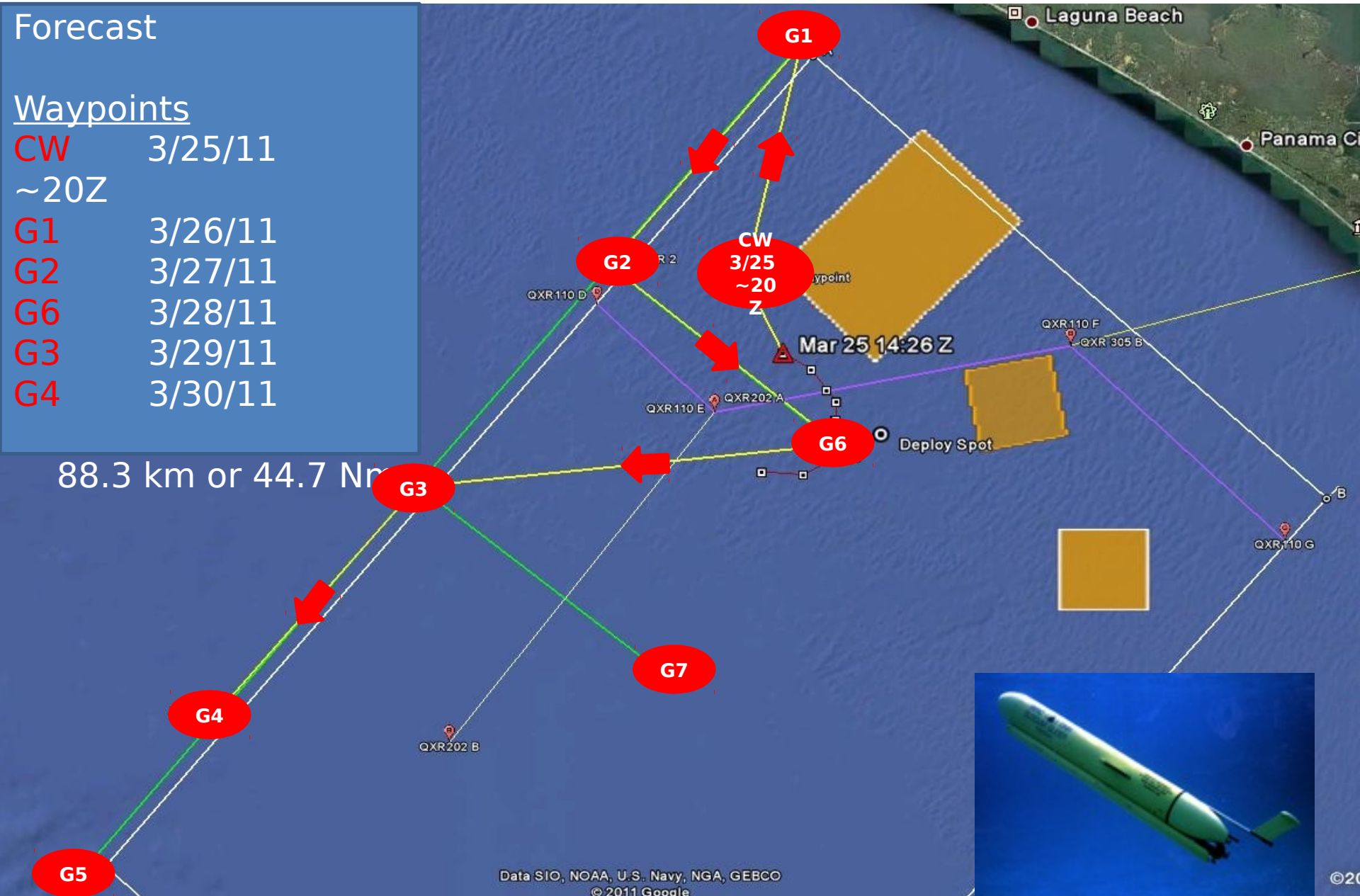
Current Glider Track and Location

Forecast

Waypoints

CW	3/25/11 ~20Z
G1	3/26/11
G2	3/27/11
G6	3/28/11
G3	3/29/11
G4	3/30/11

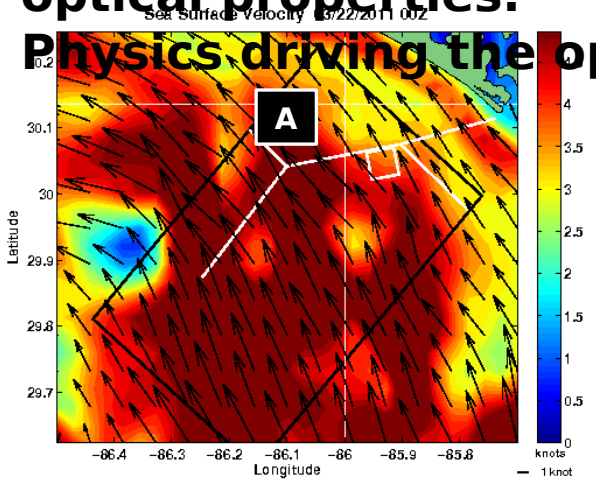
88.3 km or 44.7 Nm

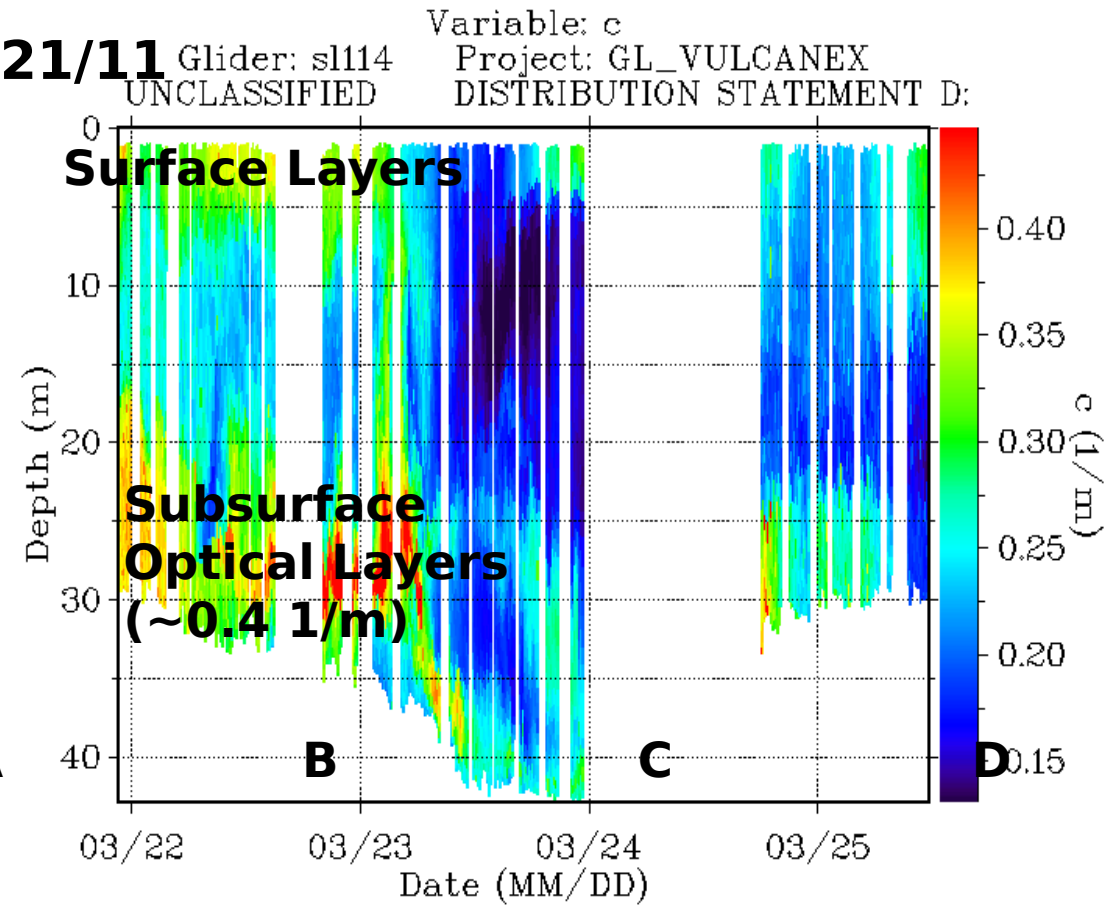


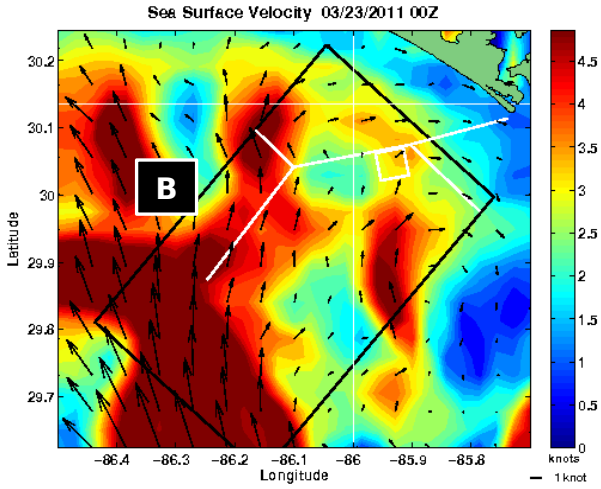
tics Glider Deployed on 3/21/11

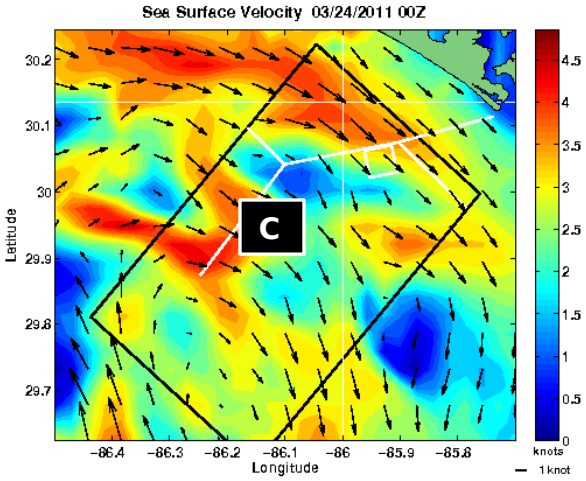
Direction and speed of surface currents can change within days causing subtle changes in surface and subsurface optical properties.

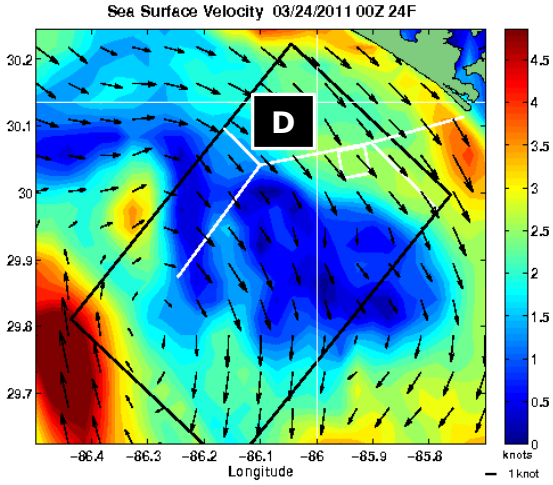
Physics driving the optics.





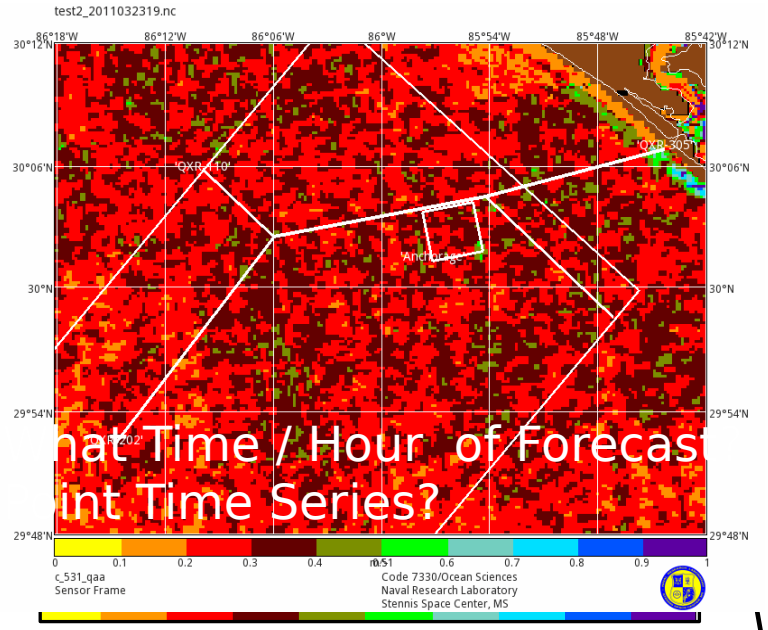




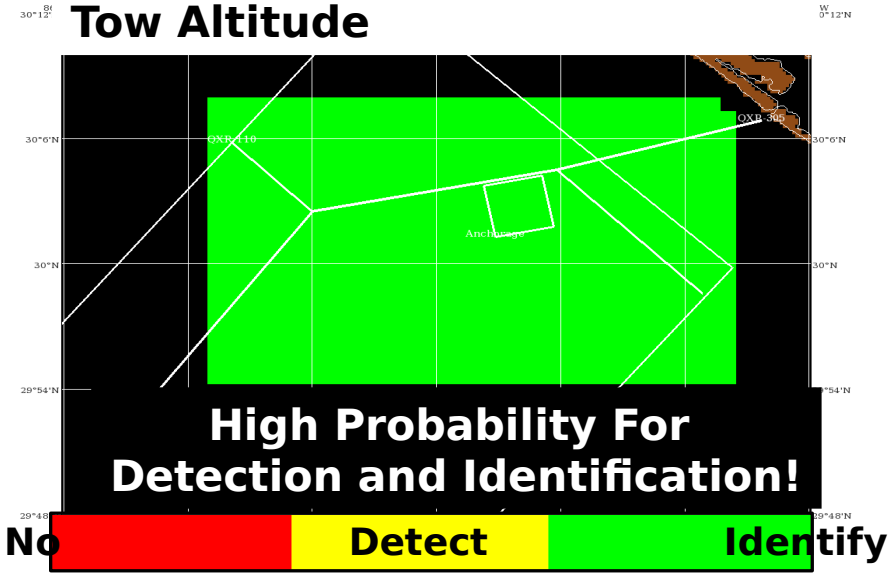


NowCast AQS-24 Support for March 23, 2011 19Z

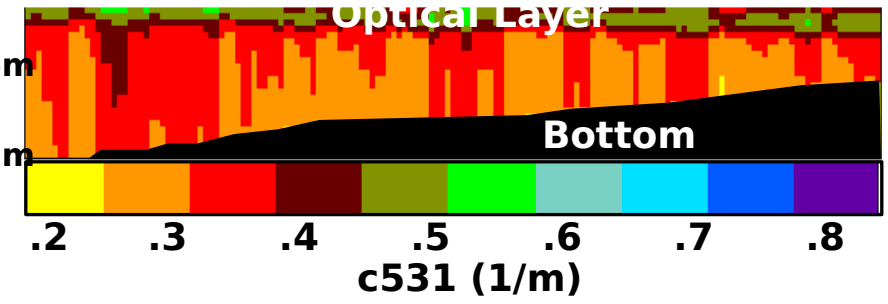
Surface Beam-c (NowCast)



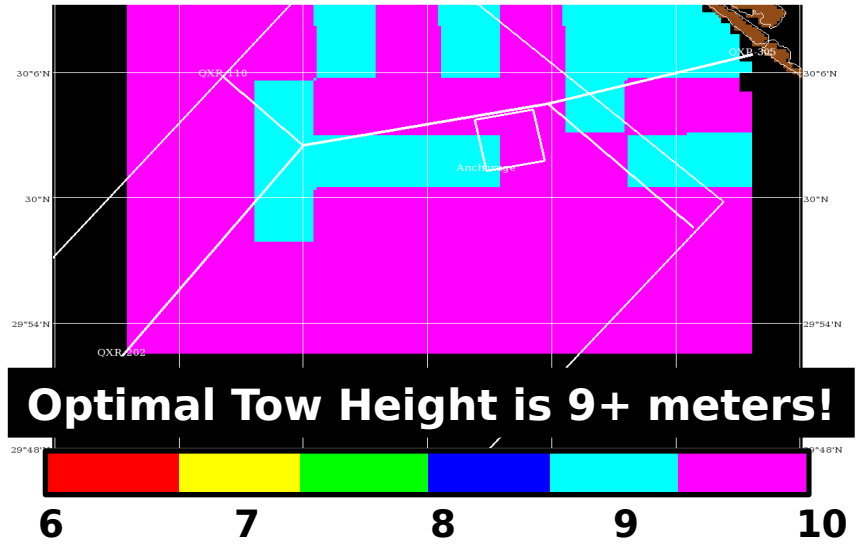
Target Identification @ 6m Tow Altitude



Beam-c 3D Slice (West->East)

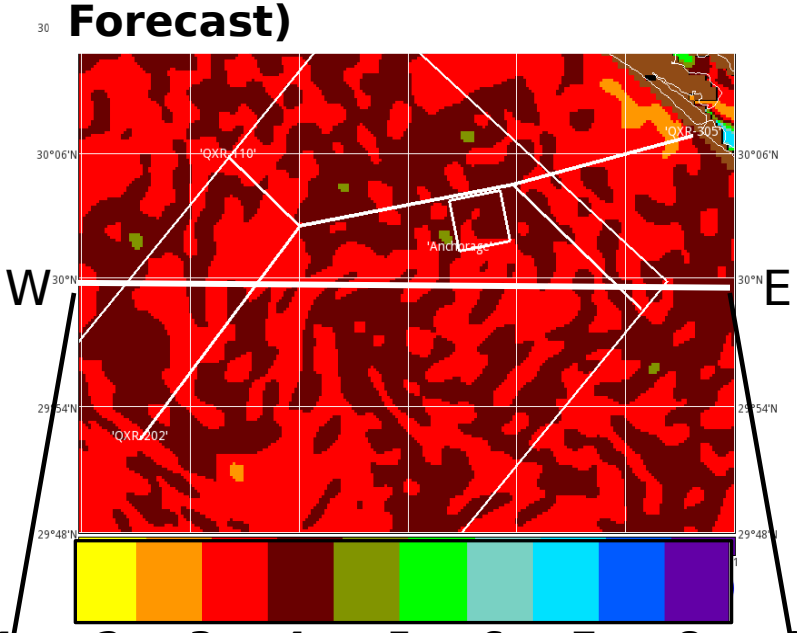


Optimal Tow Altitude



Forecast AQS-24 Support for March 24, 2011 19Z

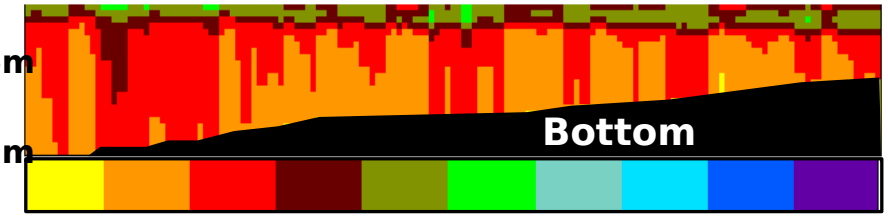
Surface Beam-c (24 Hour Forecast)



0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1>

c531 (1/m)

Beam-c 3D Slice (West->East)



0m

16m

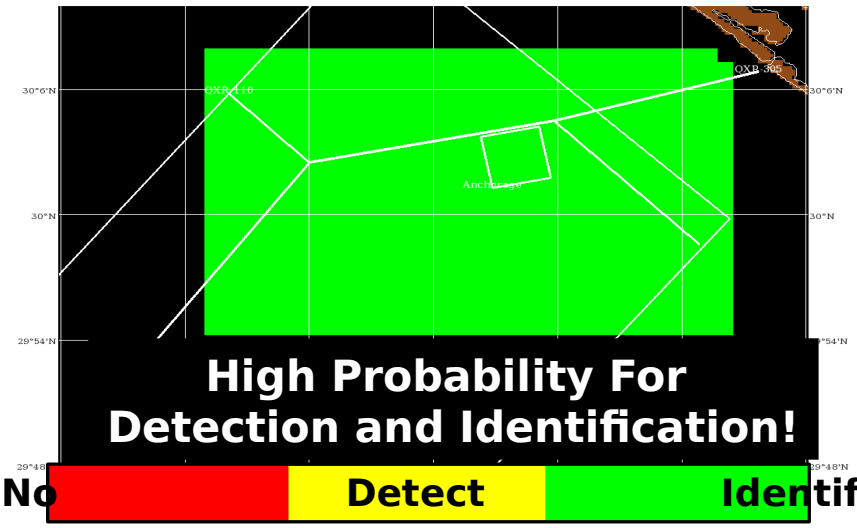
32m

.2 .3 .4 .5 .6 .7 .8 .9

c531 (1/m)

<5

Target Identification @ 6m Tow Altitude



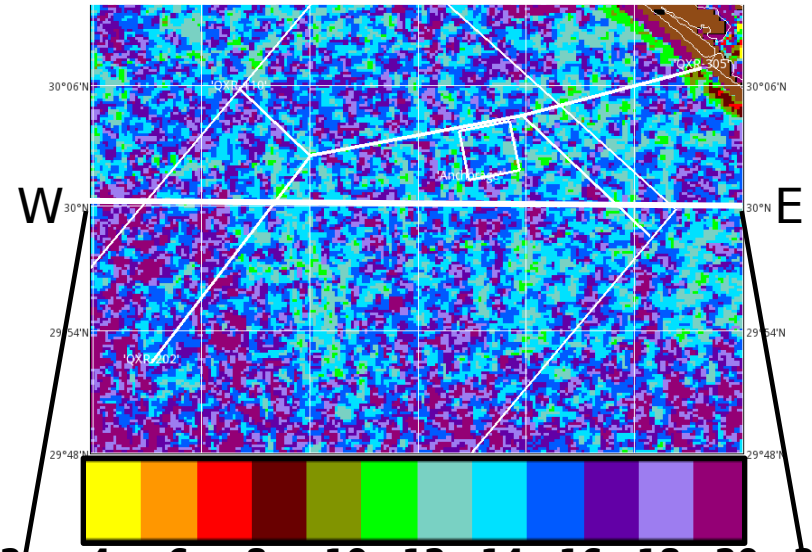
Optimal Tow Altitude = 9+ meters



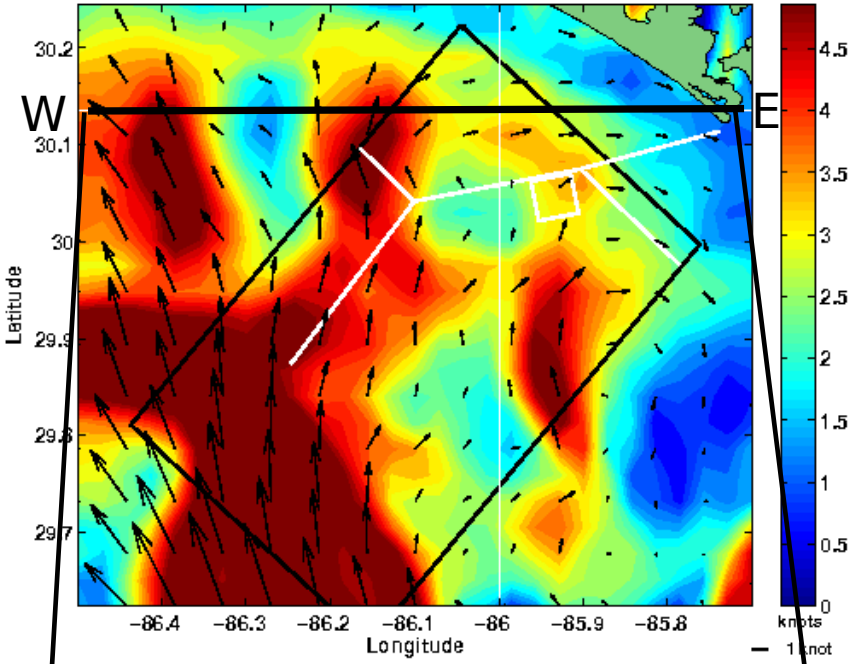
Cast Dive Support for March 23, 2011 19Z

Hourly Forecast (Satellite,Model) Available for Time Series?

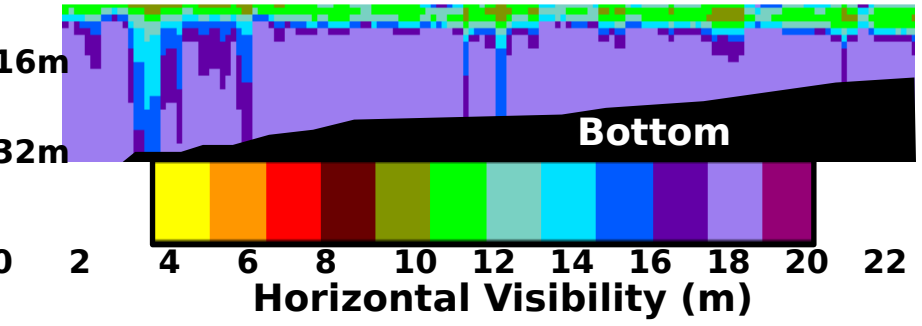
Surface Horizontal Diver Visibility (NowCast)



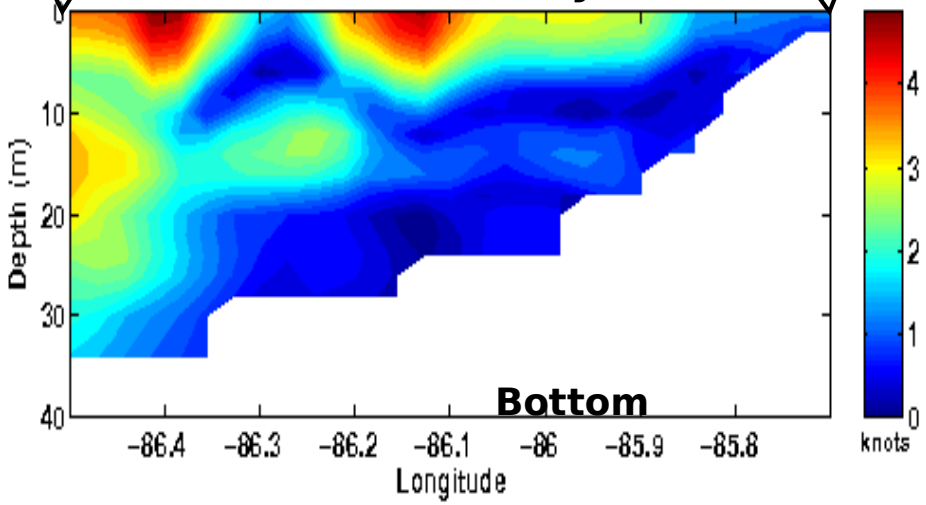
Surface Current Velocity



Diver Visibility 3D Slice (West->East)

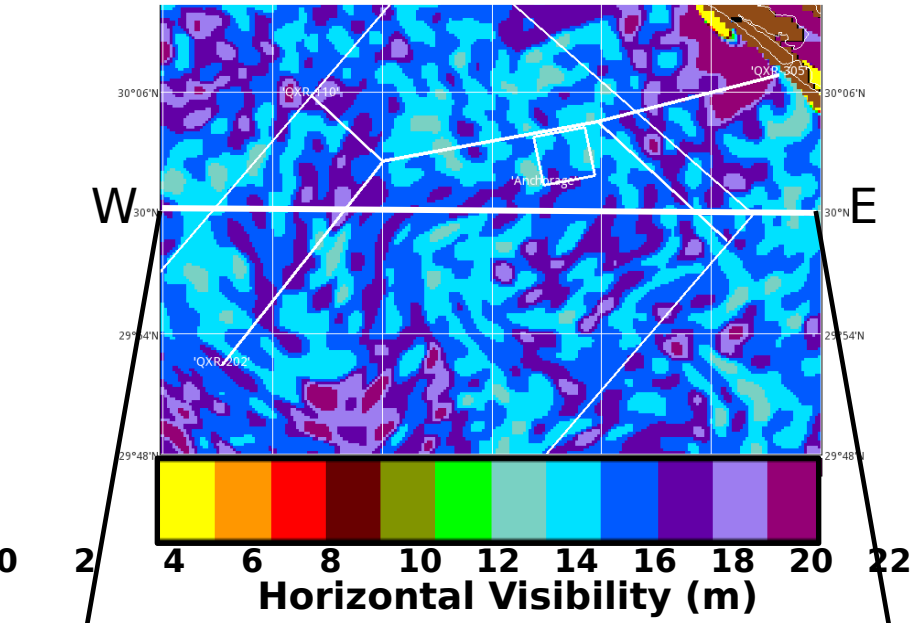


Subsurface Current Velocity Slice at 30.14

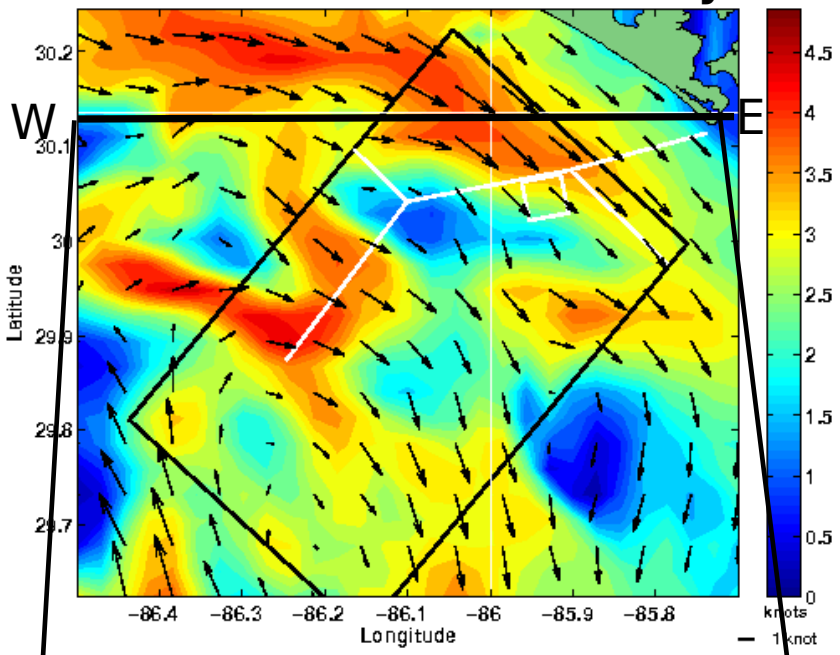


Forecasted Dive Support for March 24, 2011 19Z

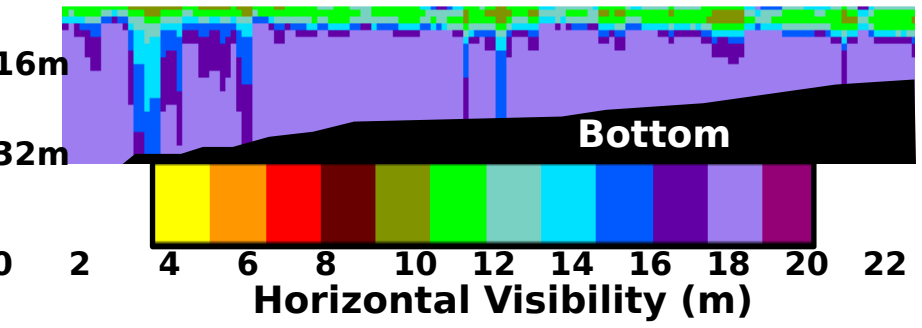
Surface Horizontal Diver Visibility (24Hr Forecast)



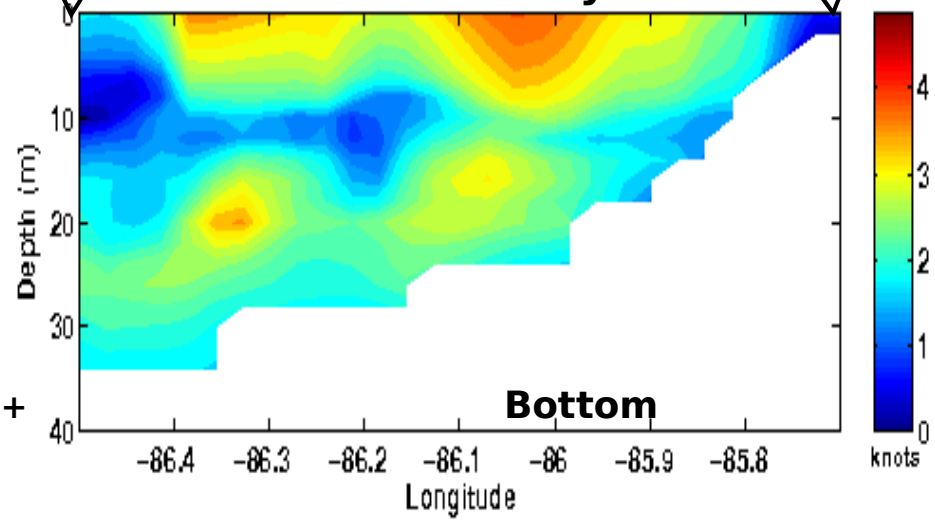
Surface Current Velocity



Diver Visibility 3D Slice (West->East)



Subsurface Current Velocity Slice at 30.14



Summary Slide – From Kevin

Questions?

ease send any feedback via email (ladner@nrlssc.navy.mil)

- Positive
- Negative
- How Products being used?
 - Changes?